FIG. 1

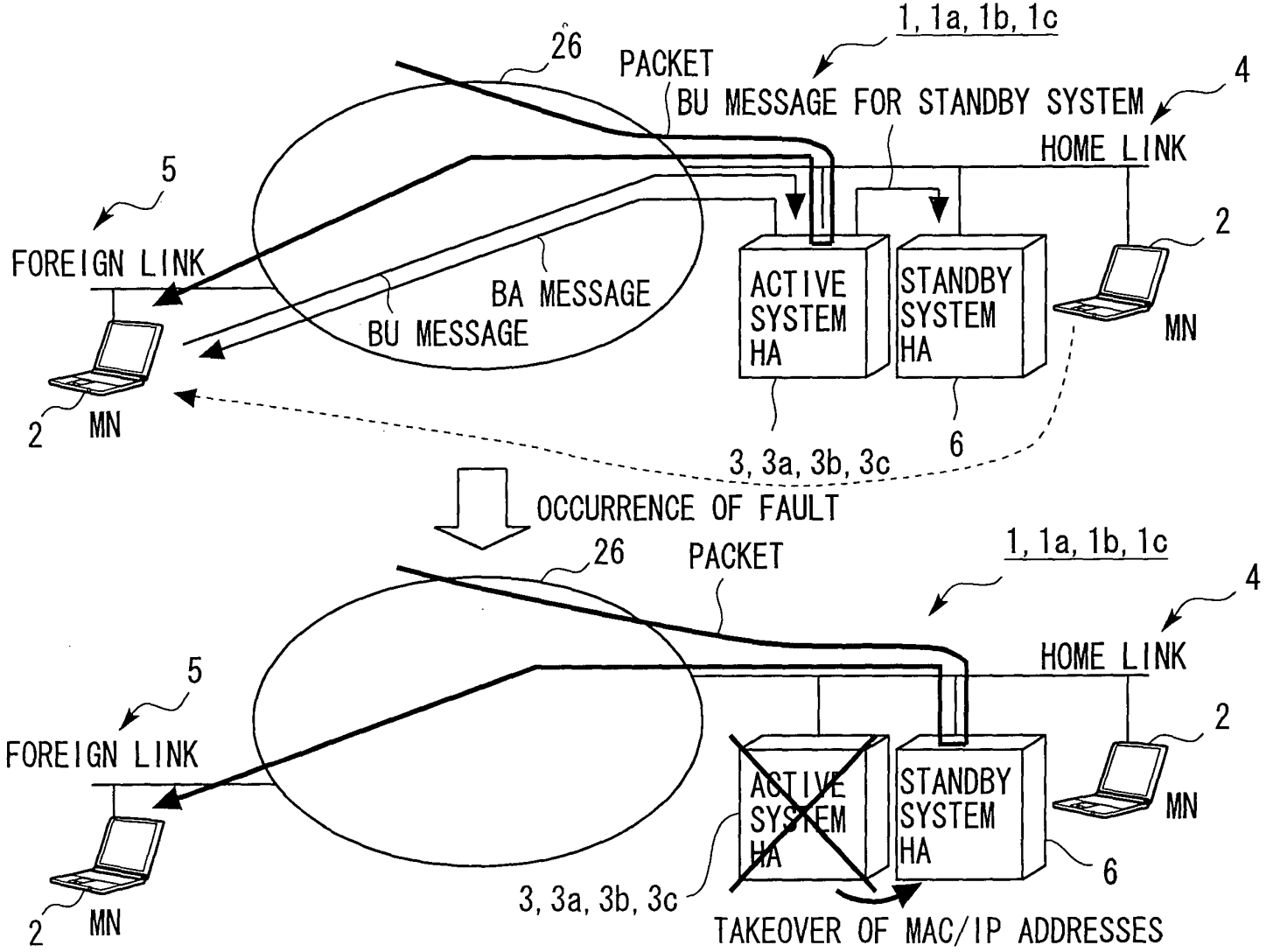

1, 1a, 1b, 1c
26
PACKET
BU MESSAGE FOR STANDBY SYSTEM
4
HOME LINK
5
FOREIGN LINK
BA MESSAGE
BU MESSAGE
ACTIVE SYSTEM HA
STANDBY SYSTEM HA
2
MN
2
MN
3, 3a, 3b, 3c
6
OCCURRENCE OF FAULT
26
PACKET
1, 1a, 1b, 1c
4
HOME LINK
5
FOREIGN LINK
ACTIVE SYSTEM HA
STANDBY SYSTEM HA
2
MN
2
MN
3, 3a, 3b, 3c
6
TAKEOVER OF MAC/IP ADDRESSES

FIG. 2

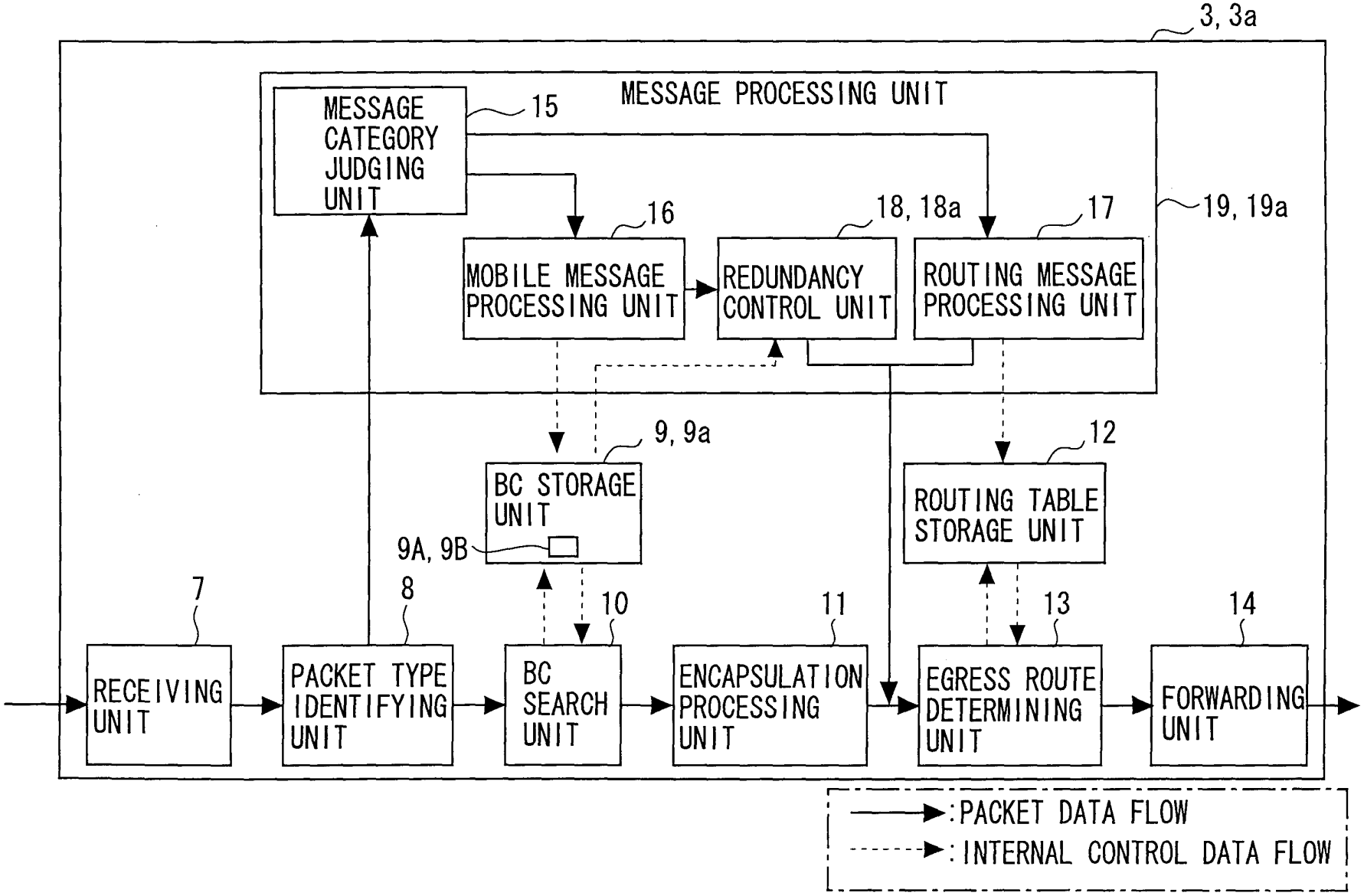

3, 3a
MESSAGE PROCESSING UNIT
MESSAGE CATEGORY JUDGING UNIT
15
16
MOBILE MESSAGE PROCESSING UNIT
18, 18a
REDUNDANCY CONTROL UNIT
17
ROUTING MESSAGE PROCESSING UNIT
19, 19a
9, 9a
BC STORAGE UNIT
9A, 9B
12
ROUTING TABLE STORAGE UNIT
7
8
10
11
13
14
RECEIVING UNIT
PACKET TYPE IDENTIFYING UNIT
BC SEARCH UNIT
ENCAPSULATION PROCESSING UNIT
EGRESS ROUTE DETERMINING UNIT
FORWARDING UNIT
:PACKET DATA FLOW
:INTERNAL CONTROL DATA FLOW

FIG. 3

9A

HOME ADDRESS (128BIT)	CoA (128BIT)	LIFE TIME (32BIT)	PREFIX LENGTH (8BIT)

FIG. 4

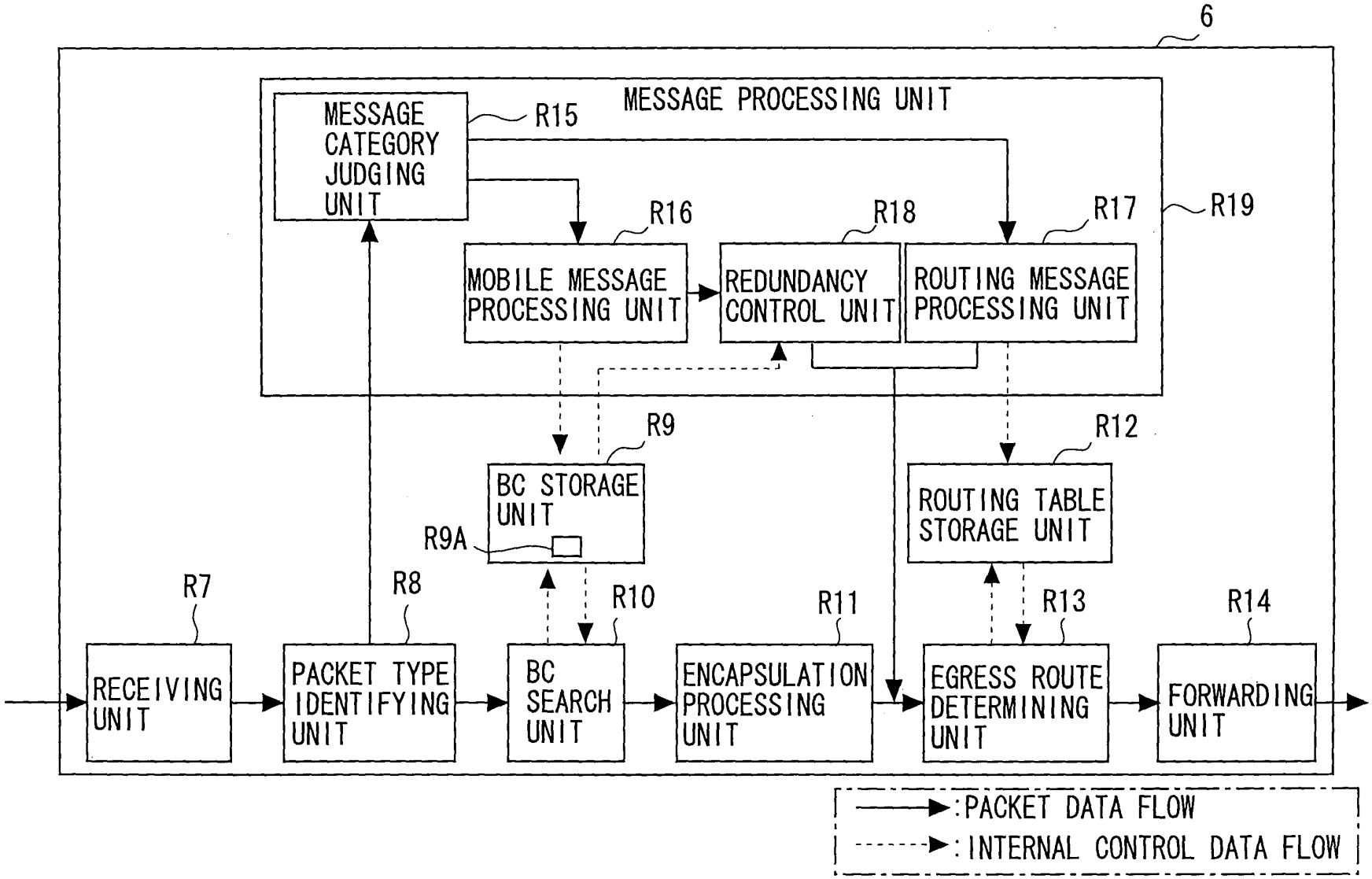

6
MESSAGE PROCESSING UNIT
MESSAGE CATEGORY JUDGING UNIT
R15
R16
R18
R17
R19
MOBILE MESSAGE PROCESSING UNIT
REDUNDANCY CONTROL UNIT
ROUTING MESSAGE PROCESSING UNIT
R9
R12
BC STORAGE UNIT
R9A
ROUTING TABLE STORAGE UNIT
R7
R8
R10
R11
R13
R14
RECEIVING UNIT
PACKET TYPE IDENTIFYING UNIT
BC SEARCH UNIT
ENCAPSULATION PROCESSING UNIT
EGRESS ROUTE DETERMINING UNIT
FORWARDING UNIT
:PACKET DATA FLOW
:INTERNAL CONTROL DATA FLOW

FIG. 5

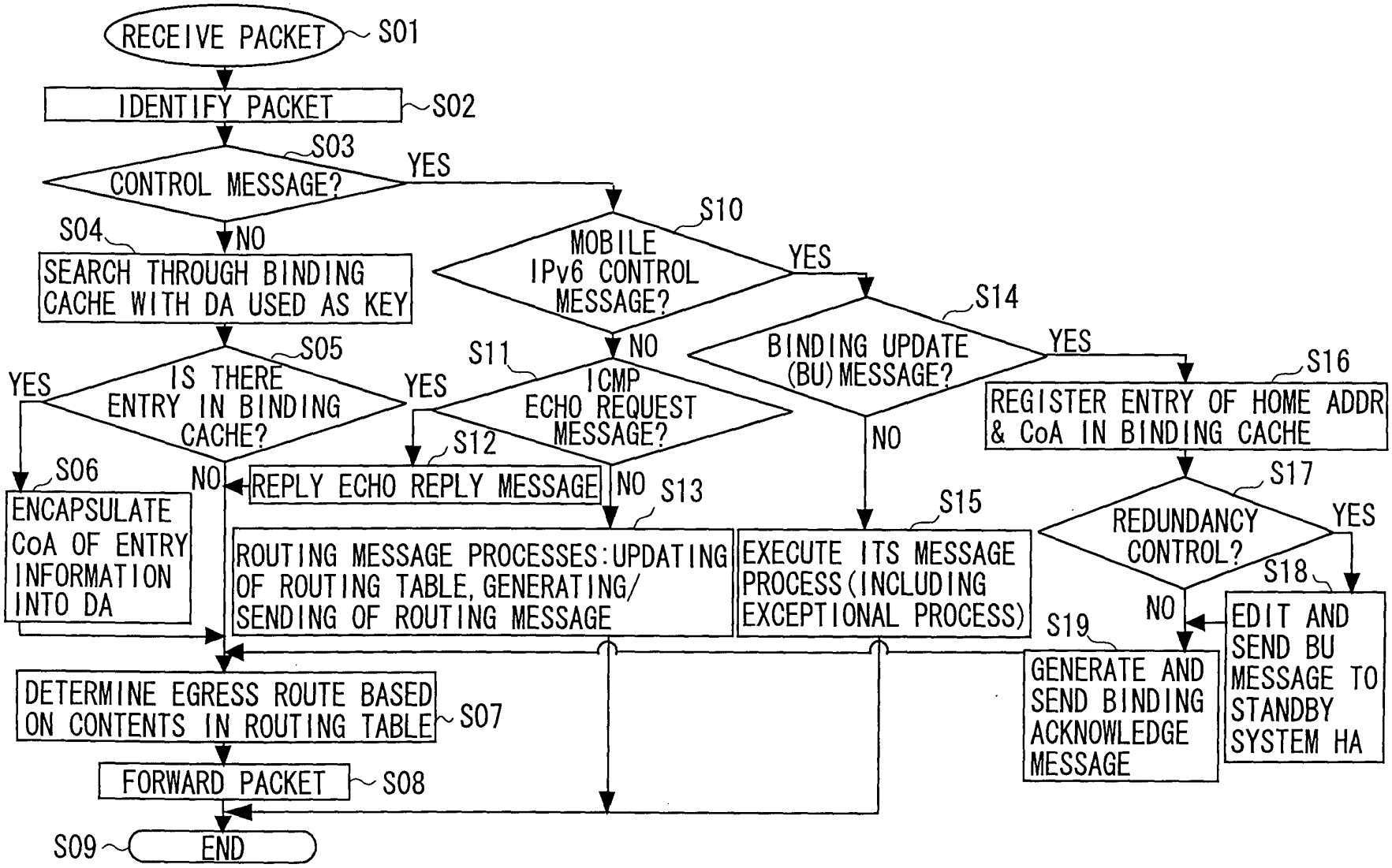

RECEIVE PACKET
S01
IDENTIFY PACKET
S02
S03
CONTROL MESSAGE?
YES
NO
S04
SEARCH THROUGH BINDING CACHE WITH DA USED AS KEY
S05
IS THERE ENTRY IN BINDING CACHE?
YES
NO
S06
ENCAPSULATE CoA OF ENTRY INFORMATION INTO DA
S10
MOBILE IPv6 CONTROL MESSAGE?
YES
NO
S11
ICMP ECHO REQUEST MESSAGE?
YES
NO
S12
REPLY ECHO REPLY MESSAGE
S13
ROUTING MESSAGE PROCESSES: UPDATING OF ROUTING TABLE, GENERATING/ SENDING OF ROUTING MESSAGE
S14
BINDING UPDATE (BU) MESSAGE?
YES
NO
S15
EXECUTE ITS MESSAGE PROCESS (INCLUDING EXCEPTIONAL PROCESS)
S16
REGISTER ENTRY OF HOME ADDR & CoA IN BINDING CACHE
S17
REDUNDANCY CONTROL?
YES
NO
S18
EDIT AND SEND BU MESSAGE TO STANDBY SYSTEM HA
S19
GENERATE AND SEND BINDING ACKNOWLEDGE MESSAGE
DETERMINE EGRESS ROUTE BASED ON CONTENTS IN ROUTING TABLE
S07
FORWARD PACKET
S08
S09
END

FIG. 6

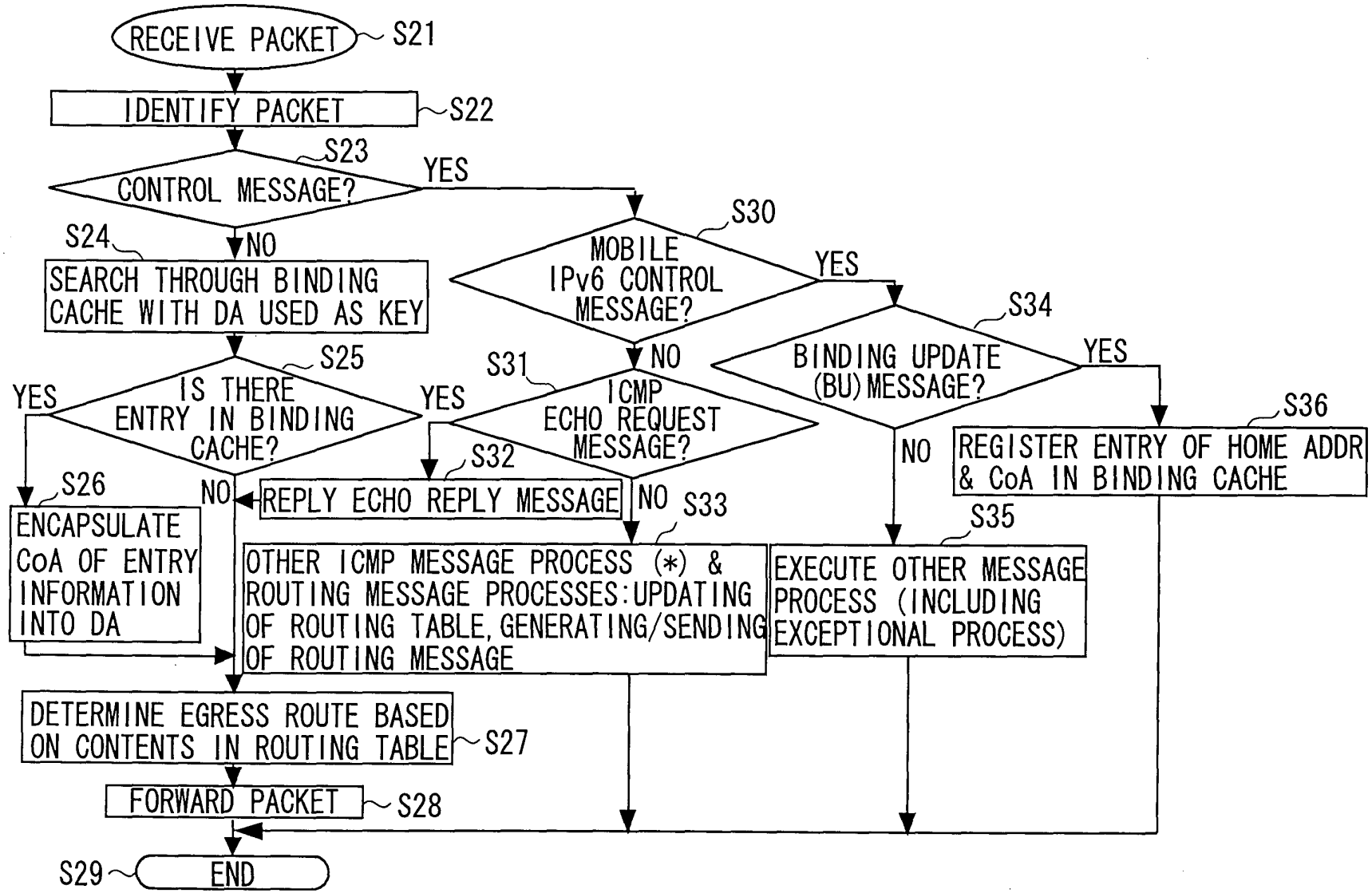

RECEIVE PACKET
S21
IDENTIFY PACKET
S22
S23
CONTROL MESSAGE?
YES
NO
S24
SEARCH THROUGH BINDING CACHE WITH DA USED AS KEY
S25
IS THERE ENTRY IN BINDING CACHE?
YES
NO
S26
ENCAPSULATE CoA OF ENTRY INFORMATION INTO DA
S30
MOBILE IPv6 CONTROL MESSAGE?
YES
NO
S31
ICMP ECHO REQUEST MESSAGE?
YES
NO
S32
REPLY ECHO REPLY MESSAGE
S33
OTHER ICMP MESSAGE PROCESS (*) & ROUTING MESSAGE PROCESSES:UPDATING OF ROUTING TABLE, GENERATING/SENDING OF ROUTING MESSAGE
S34
BINDING UPDATE (BU) MESSAGE?
YES
NO
S35
EXECUTE OTHER MESSAGE PROCESS (INCLUDING EXCEPTIONAL PROCESS)
S36
REGISTER ENTRY OF HOME ADDR & CoA IN BINDING CACHE
DETERMINE EGRESS ROUTE BASED ON CONTENTS IN ROUTING TABLE
S27
FORWARD PACKET
S28
S29
END

FIG. 7

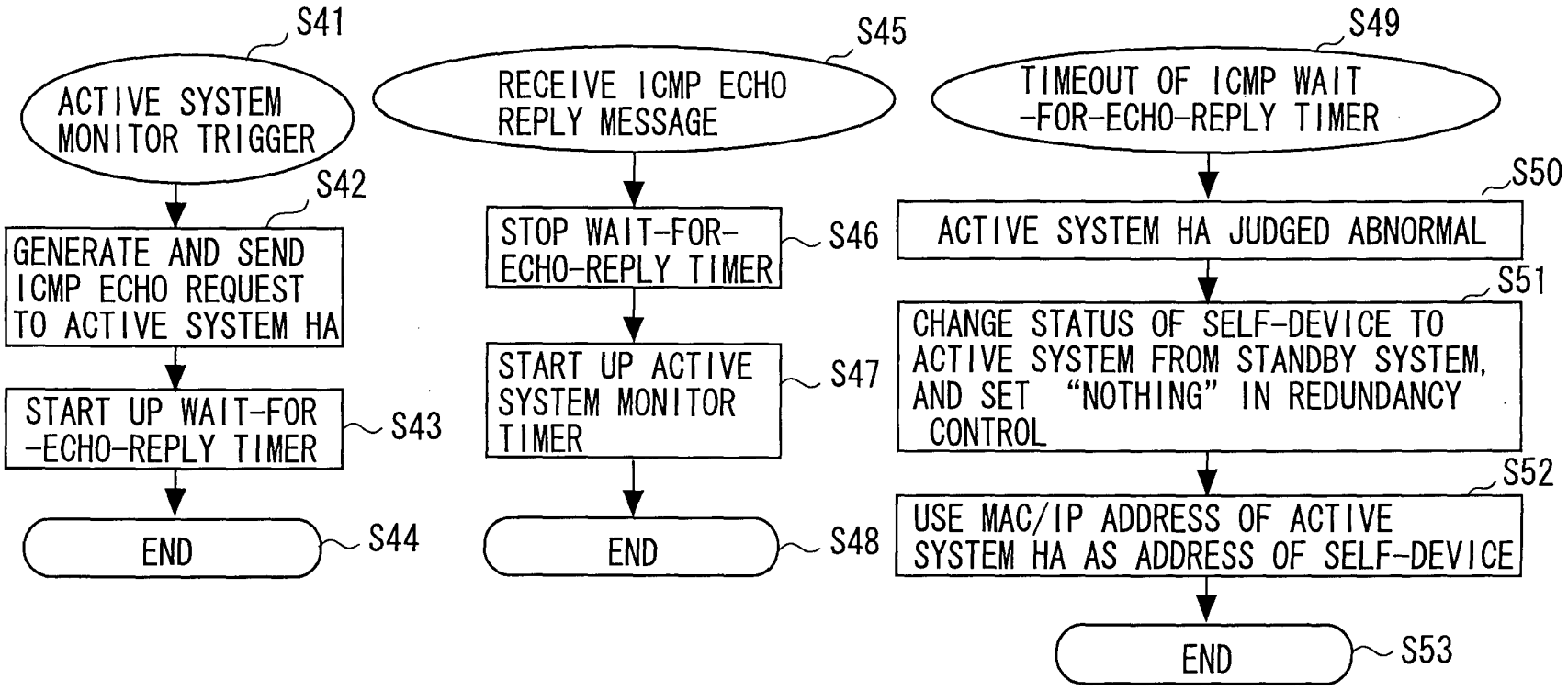

S41
ACTIVE SYSTEM MONITOR TRIGGER
S42
GENERATE AND SEND ICMP ECHO REQUEST TO ACTIVE SYSTEM HA
START UP WAIT-FOR-ECHO-REPLY TIMER
S43
END
S44
S45
RECEIVE ICMP ECHO REPLY MESSAGE
STOP WAIT-FOR-ECHO-REPLY TIMER
S46
START UP ACTIVE SYSTEM MONITOR TIMER
S47
END
S48
S49
TIMEOUT OF ICMP WAIT-FOR-ECHO-REPLY TIMER
S50
ACTIVE SYSTEM HA JUDGED ABNORMAL
S51
CHANGE STATUS OF SELF-DEVICE TO ACTIVE SYSTEM FROM STANDBY SYSTEM, AND SET "NOTHING" IN REDUNDANCY CONTROL
S52
USE MAC/IP ADDRESS OF ACTIVE SYSTEM HA AS ADDRESS OF SELF-DEVICE
END
S53

FIG. 8

9B

HOME ADDRESS (128BIT)	CoA (128BIT)	LIFE TIME (32BIT)	PREFIX LENGTH (8BIT)	PRIORITY FLAG (1 BIT)

FIG. 9

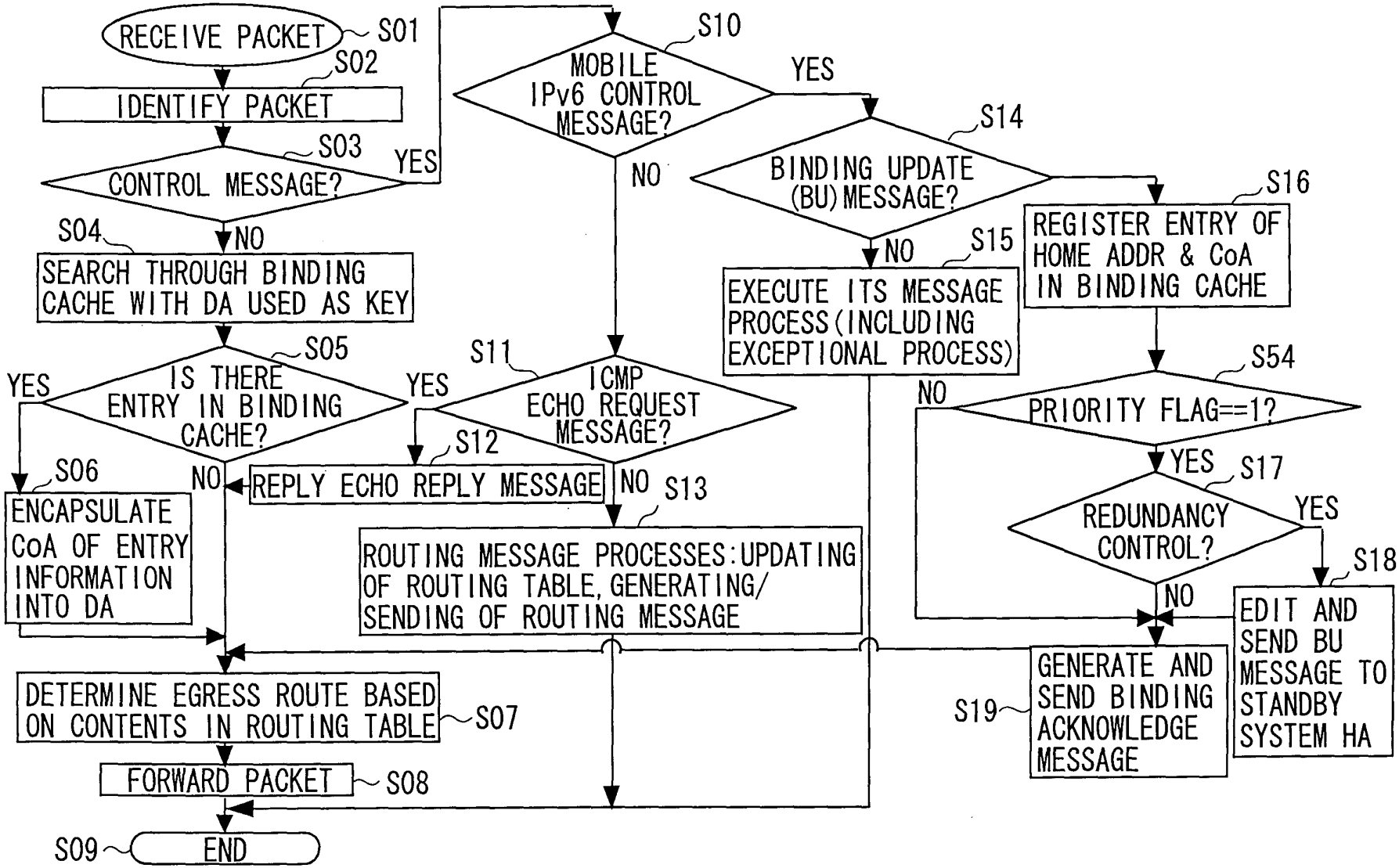

RECEIVE PACKET
S01
IDENTIFY PACKET
S02
CONTROL MESSAGE?
S03
YES
NO
SEARCH THROUGH BINDING CACHE WITH DA USED AS KEY
S04
IS THERE ENTRY IN BINDING CACHE?
S05
YES
NO
ENCAPSULATE CoA OF ENTRY INFORMATION INTO DA
S06
DETERMINE EGRESS ROUTE BASED ON CONTENTS IN ROUTING TABLE
S07
FORWARD PACKET
S08
END
S09
MOBILE IPv6 CONTROL MESSAGE?
S10
YES
NO
ICMP ECHO REQUEST MESSAGE?
S11
YES
NO
REPLY ECHO REPLY MESSAGE
S12
ROUTING MESSAGE PROCESSES: UPDATING OF ROUTING TABLE, GENERATING/ SENDING OF ROUTING MESSAGE
S13
BINDING UPDATE (BU) MESSAGE?
S14
YES
NO
EXECUTE ITS MESSAGE PROCESS (INCLUDING EXCEPTIONAL PROCESS)
S15
REGISTER ENTRY OF HOME ADDR & CoA IN BINDING CACHE
S16
PRIORITY FLAG==1?
S54
NO
YES
REDUNDANCY CONTROL?
S17
YES
NO
EDIT AND SEND BU MESSAGE TO STANDBY SYSTEM HA
S18
GENERATE AND SEND BINDING ACKNOWLEDGE MESSAGE
S19

FIG. 10

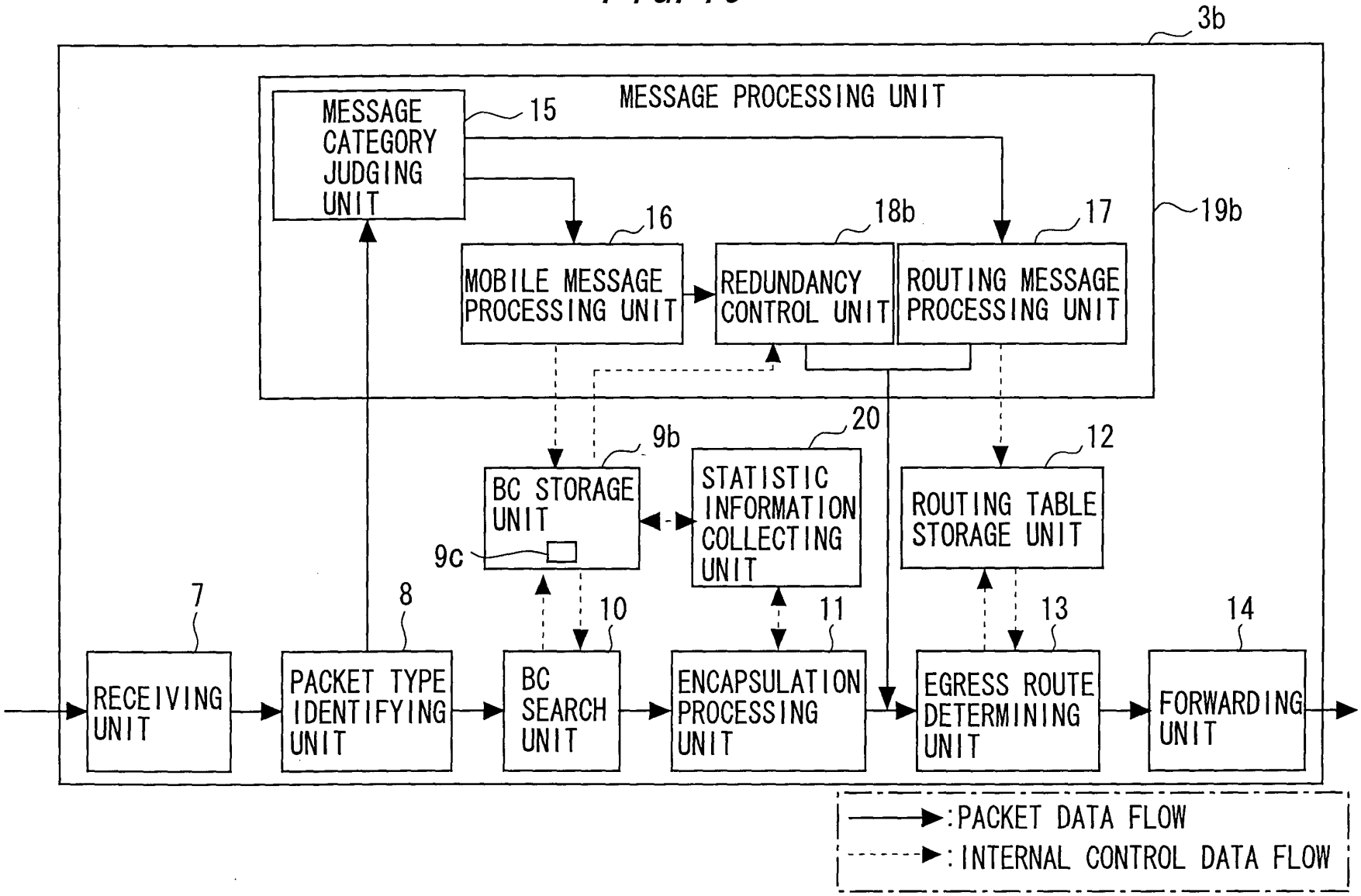

3b
MESSAGE PROCESSING UNIT
MESSAGE CATEGORY JUDGING UNIT
15
16
18b
17
19b
MOBILE MESSAGE PROCESSING UNIT
REDUNDANCY CONTROL UNIT
ROUTING MESSAGE PROCESSING UNIT
20
9b
12
BC STORAGE UNIT
9c
STATISTIC INFORMATION COLLECTING UNIT
ROUTING TABLE STORAGE UNIT
7
8
10
11
13
14
RECEIVING UNIT
PACKET TYPE IDENTIFYING UNIT
BC SEARCH UNIT
ENCAPSULATION PROCESSING UNIT
EGRESS ROUTE DETERMINING UNIT
FORWARDING UNIT
:PACKET DATA FLOW
:INTERNAL CONTROL DATA FLOW

FIG. 11

9C

HOME ADDRESS (128BIT)	CoA (128BIT)	LIFE TIME (32BIT)	PREFIX LENGTH (8BIT)	STATISTIC INFORMATION

FIG. 12

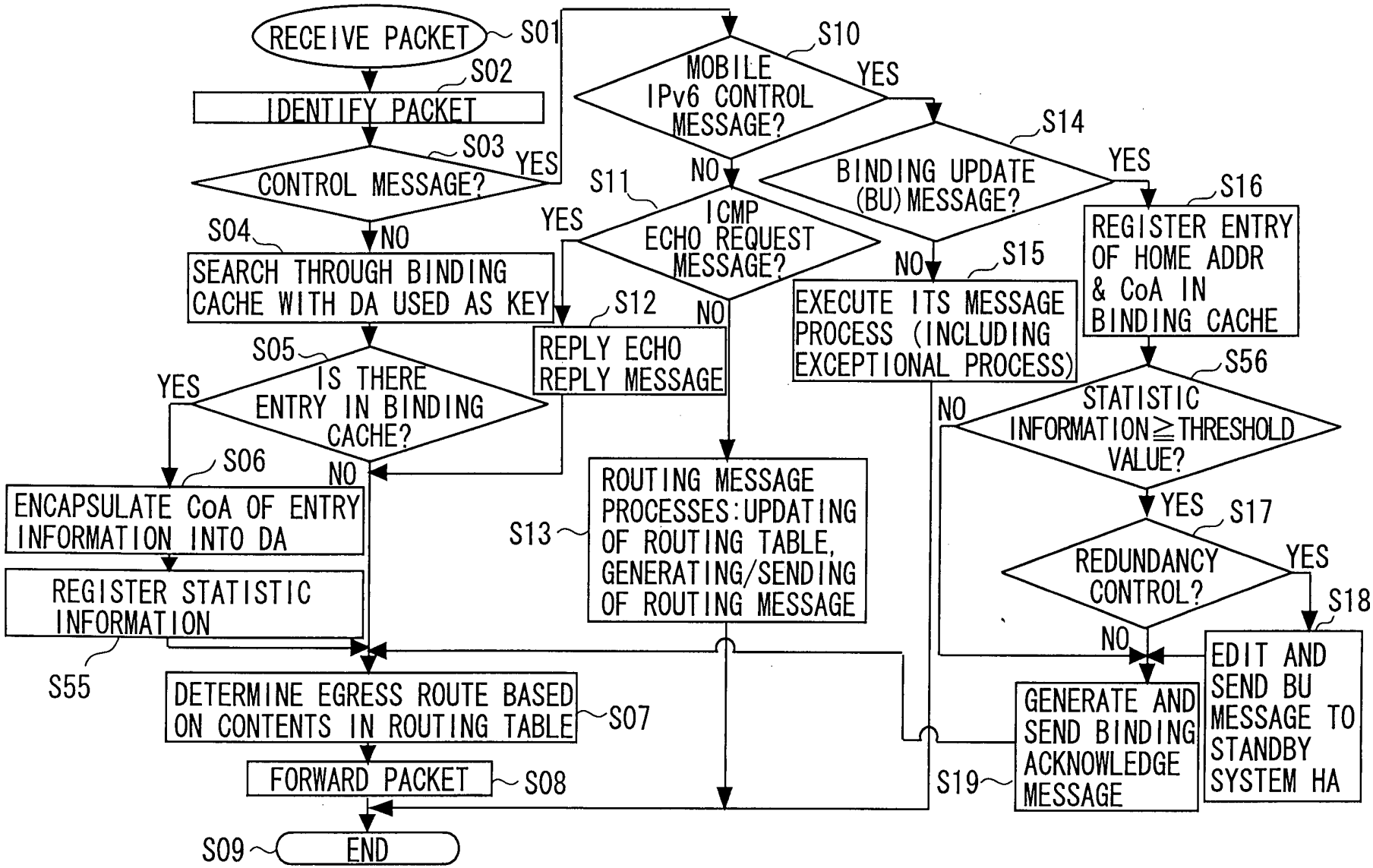

RECEIVE PACKET
S01
IDENTIFY PACKET
S02
CONTROL MESSAGE?
S03
YES
NO
SEARCH THROUGH BINDING CACHE WITH DA USED AS KEY
S04
IS THERE ENTRY IN BINDING CACHE?
S05
YES
NO
ENCAPSULATE CoA OF ENTRY INFORMATION INTO DA
S06
REGISTER STATISTIC INFORMATION
S55
MOBILE IPv6 CONTROL MESSAGE?
S10
YES
NO
ICMP ECHO REQUEST MESSAGE?
S11
YES
NO
REPLY ECHO REPLY MESSAGE
S12
ROUTING MESSAGE PROCESSES: UPDATING OF ROUTING TABLE, GENERATING/SENDING OF ROUTING MESSAGE
S13
BINDING UPDATE (BU) MESSAGE?
S14
YES
NO
EXECUTE ITS MESSAGE PROCESS (INCLUDING EXCEPTIONAL PROCESS)
S15
REGISTER ENTRY OF HOME ADDR & CoA IN BINDING CACHE
S16
STATISTIC INFORMATION≧THRESHOLD VALUE?
S56
NO
YES
REDUNDANCY CONTROL?
S17
YES
NO
EDIT AND SEND BU MESSAGE TO STANDBY SYSTEM HA
S18
GENERATE AND SEND BINDING ACKNOWLEDGE MESSAGE
S19
DETERMINE EGRESS ROUTE BASED ON CONTENTS IN ROUTING TABLE
S07
FORWARD PACKET
S08
END
S09

FIG. 13

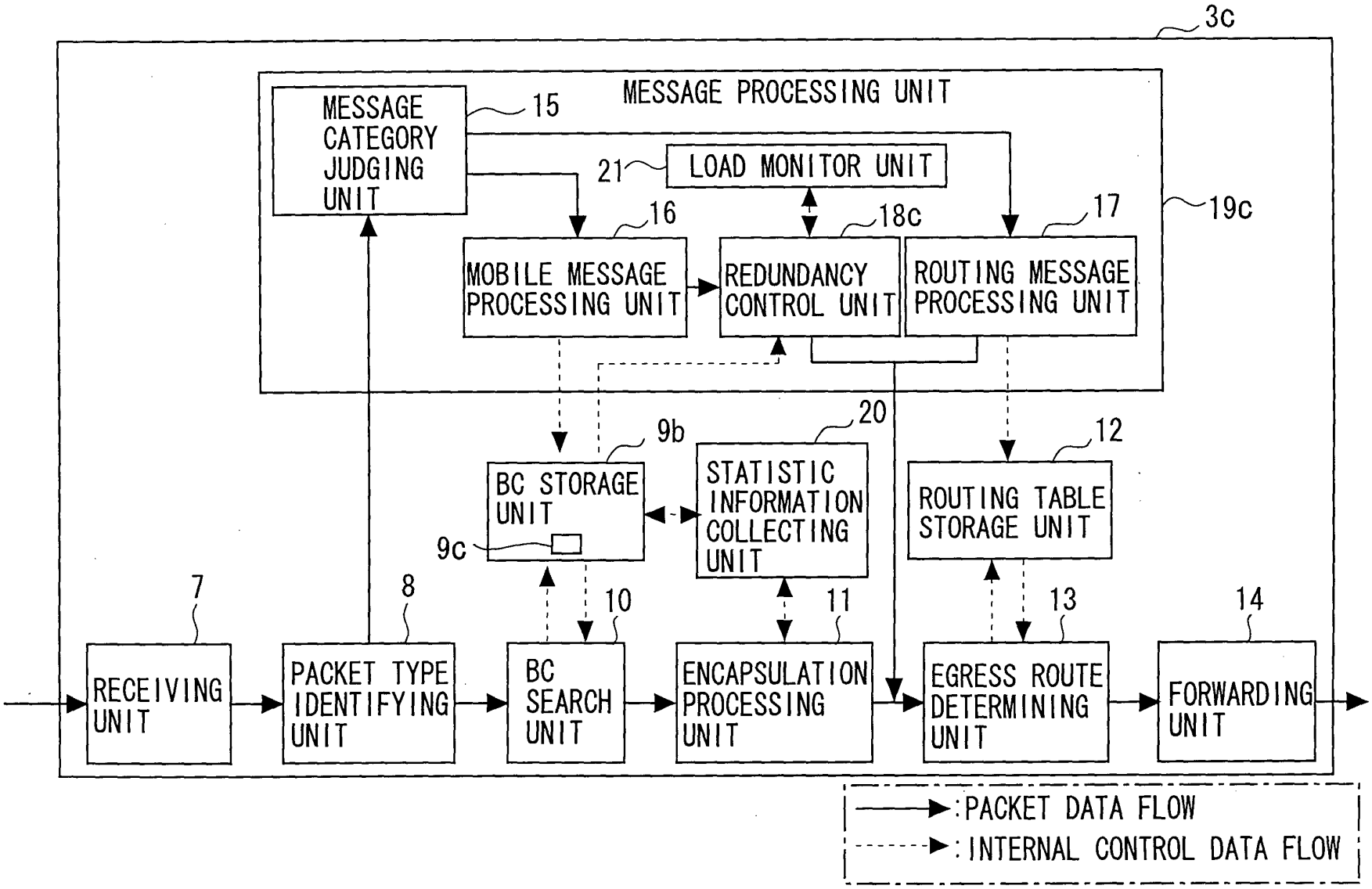

3c
MESSAGE PROCESSING UNIT
MESSAGE CATEGORY JUDGING UNIT
15
21
LOAD MONITOR UNIT
16
18c
17
19c
MOBILE MESSAGE PROCESSING UNIT
REDUNDANCY CONTROL UNIT
ROUTING MESSAGE PROCESSING UNIT
20
9b
12
BC STORAGE UNIT
9c
STATISTIC INFORMATION COLLECTING UNIT
ROUTING TABLE STORAGE UNIT
7
8
10
11
13
14
RECEIVING UNIT
PACKET TYPE IDENTIFYING UNIT
BC SEARCH UNIT
ENCAPSULATION PROCESSING UNIT
EGRESS ROUTE DETERMINING UNIT
FORWARDING UNIT
:PACKET DATA FLOW
:INTERNAL CONTROL DATA FLOW

FIG. 14

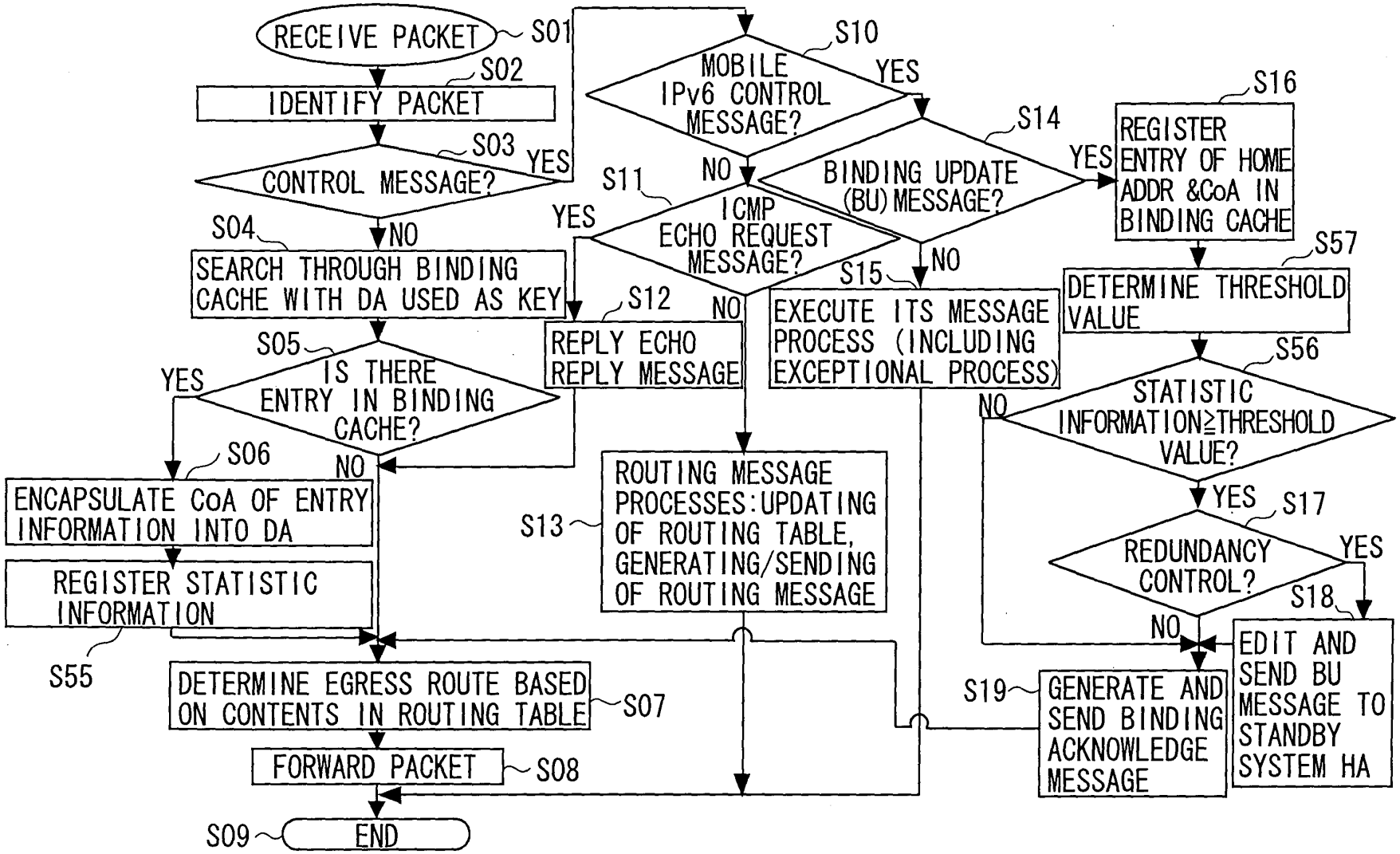

RECEIVE PACKET
S01
IDENTIFY PACKET
S02
CONTROL MESSAGE?
S03
YES
NO
SEARCH THROUGH BINDING CACHE WITH DA USED AS KEY
S04
IS THERE ENTRY IN BINDING CACHE?
S05
YES
NO
ENCAPSULATE CoA OF ENTRY INFORMATION INTO DA
S06
REGISTER STATISTIC INFORMATION
S55
MOBILE IPv6 CONTROL MESSAGE?
S10
YES
NO
ICMP ECHO REQUEST MESSAGE?
S11
YES
NO
REPLY ECHO REPLY MESSAGE
S12
ROUTING MESSAGE PROCESSES: UPDATING OF ROUTING TABLE, GENERATING/SENDING OF ROUTING MESSAGE
S13
BINDING UPDATE (BU) MESSAGE?
S14
YES
NO
EXECUTE ITS MESSAGE PROCESS (INCLUDING EXCEPTIONAL PROCESS)
S15
REGISTER ENTRY OF HOME ADDR &CoA IN BINDING CACHE
S16
DETERMINE THRESHOLD VALUE
S57
STATISTIC INFORMATION≥THRESHOLD VALUE?
S56
NO
YES
REDUNDANCY CONTROL?
S17
YES
NO
EDIT AND SEND BU MESSAGE TO STANDBY SYSTEM HA
S18
GENERATE AND SEND BINDING ACKNOWLEDGE MESSAGE
S19
DETERMINE EGRESS ROUTE BASED ON CONTENTS IN ROUTING TABLE
S07
FORWARD PACKET
S08
END
S09

FIG. 15

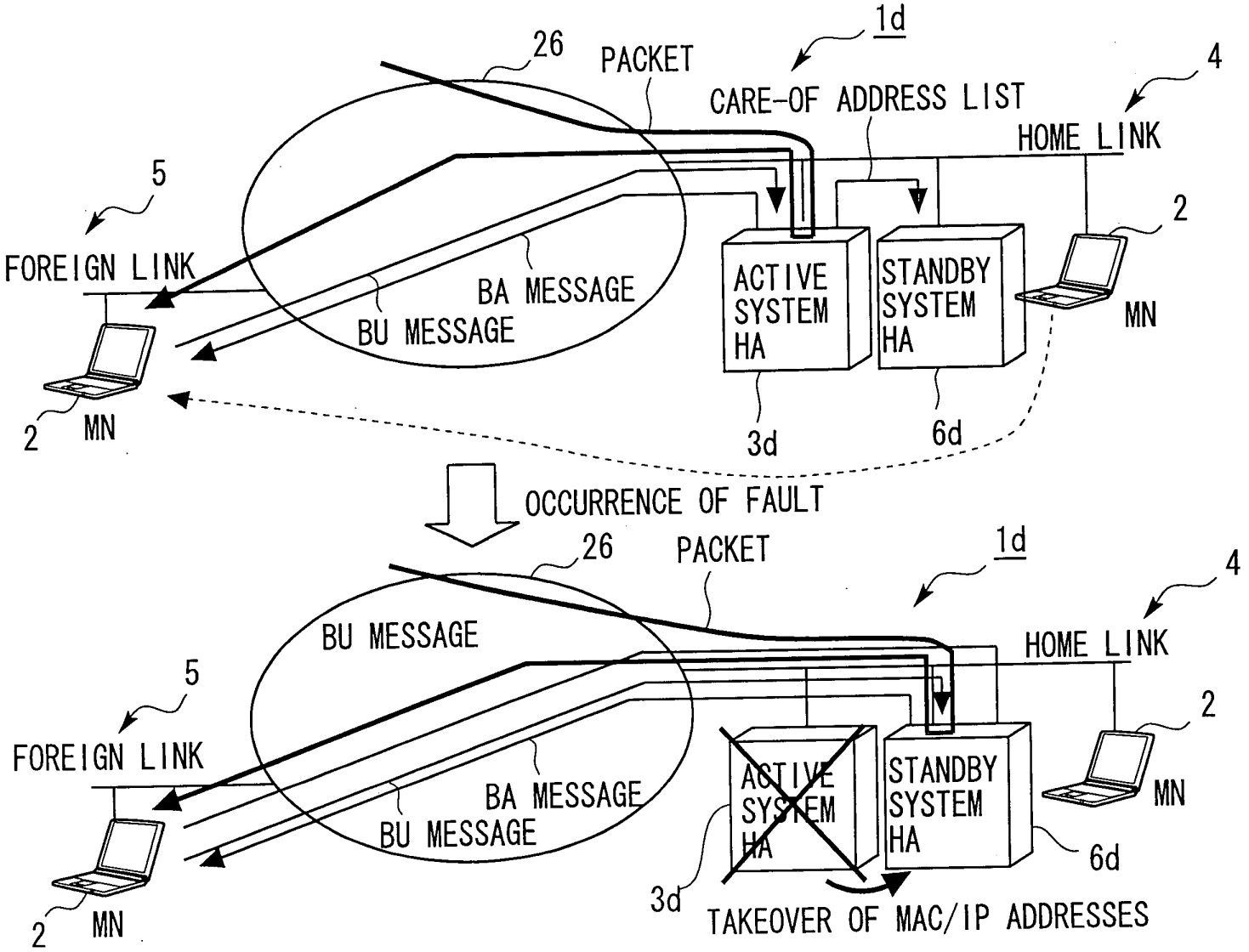

1d
26
PACKET
CARE-OF ADDRESS LIST
4
HOME LINK
5
FOREIGN LINK
BA MESSAGE
BU MESSAGE
ACTIVE SYSTEM HA
STANDBY SYSTEM HA
2
MN
3d
6d
OCCURRENCE OF FAULT
TAKEOVER OF MAC/IP ADDRESSES

FIG. 16

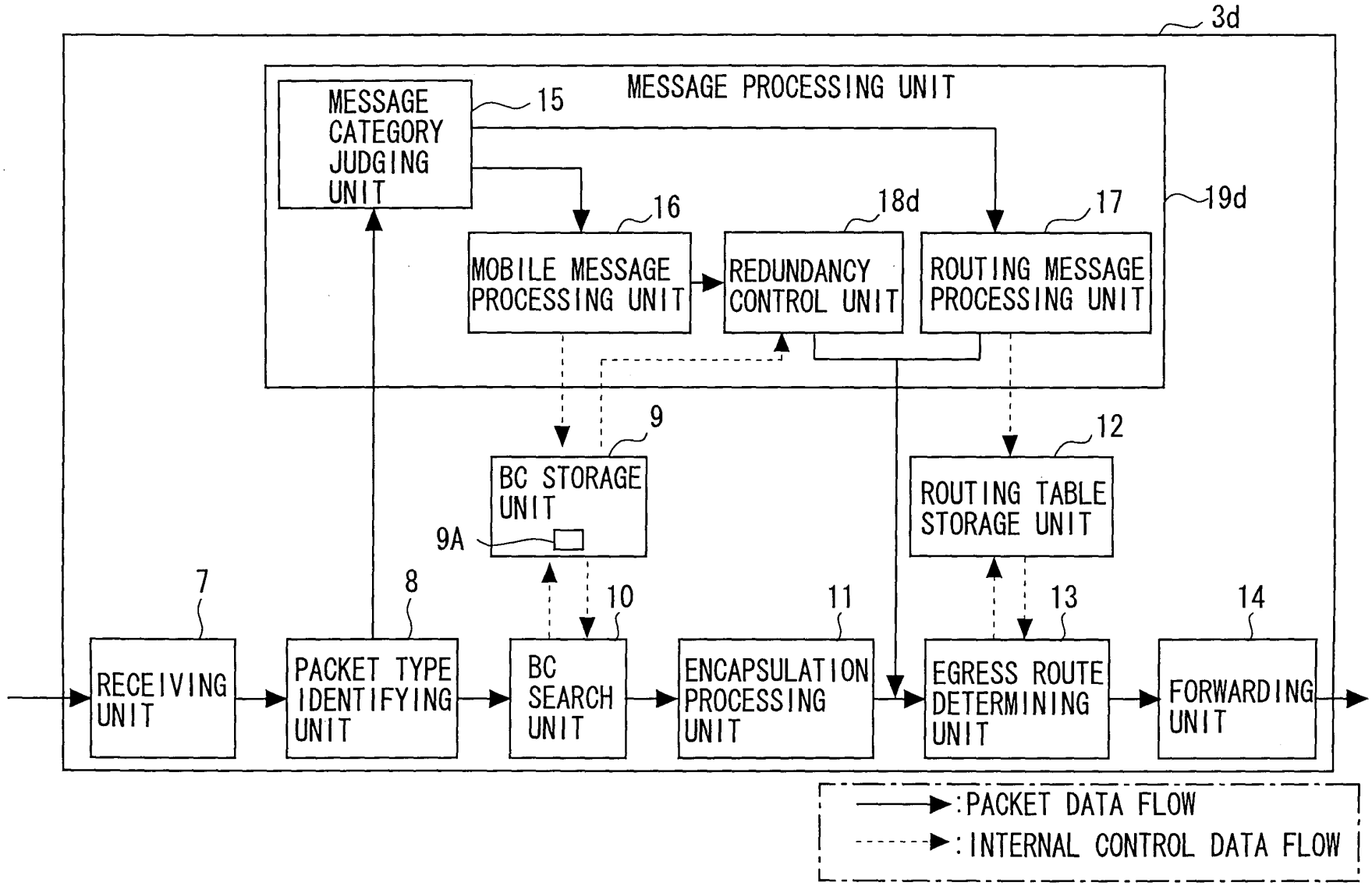

3d
MESSAGE PROCESSING UNIT
MESSAGE CATEGORY JUDGING UNIT
15
MOBILE MESSAGE PROCESSING UNIT
16
REDUNDANCY CONTROL UNIT
18d
ROUTING MESSAGE PROCESSING UNIT
17
19d
BC STORAGE UNIT
9
9A
ROUTING TABLE STORAGE UNIT
12
7
8
10
11
13
14
RECEIVING UNIT
PACKET TYPE IDENTIFYING UNIT
BC SEARCH UNIT
ENCAPSULATION PROCESSING UNIT
EGRESS ROUTE DETERMINING UNIT
FORWARDING UNIT
:PACKET DATA FLOW
:INTERNAL CONTROL DATA FLOW

FIG. 17

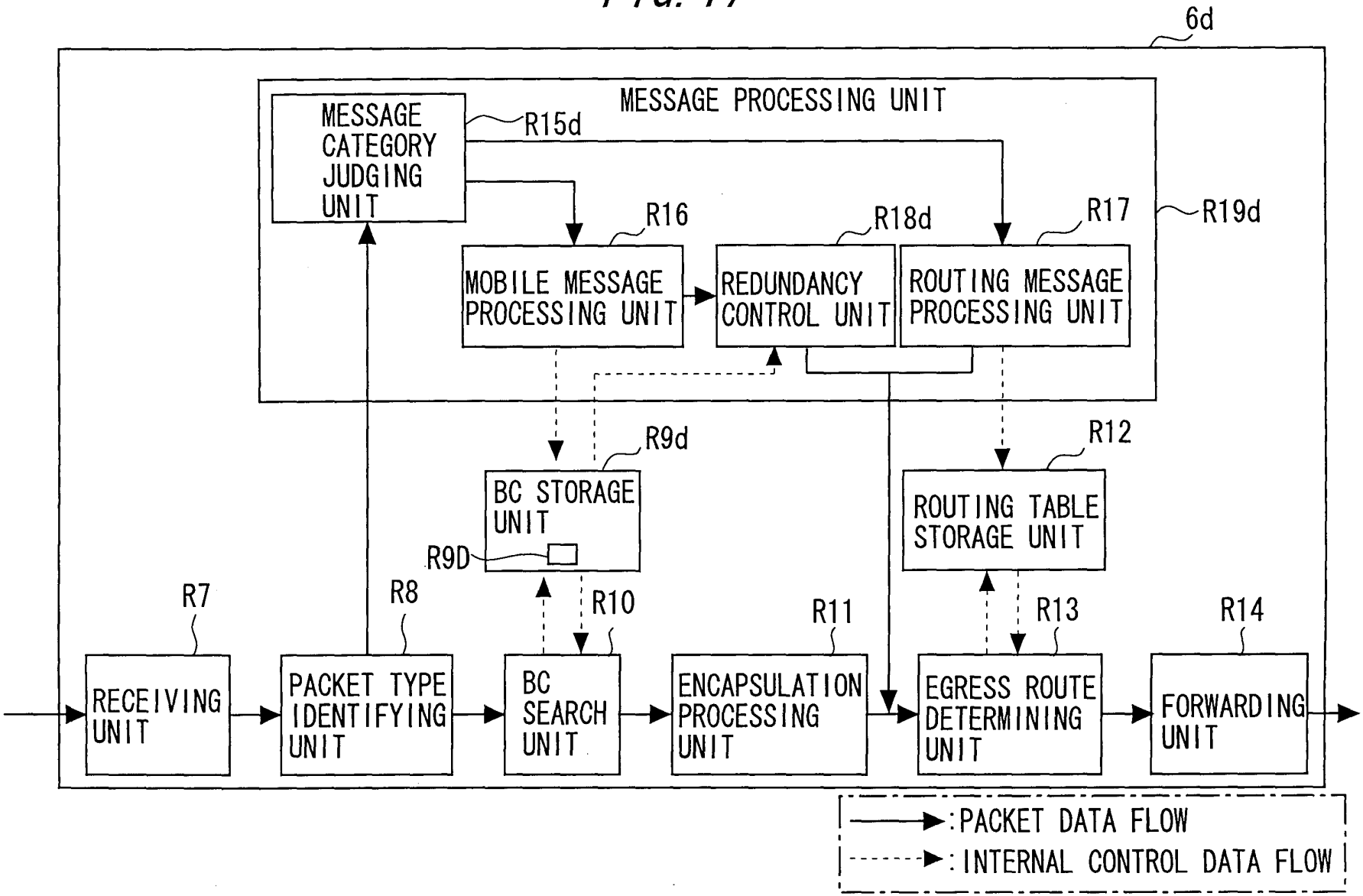

6d
MESSAGE PROCESSING UNIT
MESSAGE CATEGORY JUDGING UNIT
R15d
R16
R18d
R17
R19d
MOBILE MESSAGE PROCESSING UNIT
REDUNDANCY CONTROL UNIT
ROUTING MESSAGE PROCESSING UNIT
R9d
R12
BC STORAGE UNIT
R9D
ROUTING TABLE STORAGE UNIT
R7
R8
R10
R11
R13
R14
RECEIVING UNIT
PACKET TYPE IDENTIFYING UNIT
BC SEARCH UNIT
ENCAPSULATION PROCESSING UNIT
EGRESS ROUTE DETERMINING UNIT
FORWARDING UNIT
:PACKET DATA FLOW
:INTERNAL CONTROL DATA FLOW

FIG. 18

R9D

HOME ADDRESS (128BIT)	CoA (128BIT)	LIFE TIME (32BIT)	PREFIX LENGTH (8BIT)	REDUNDANCY FLAG (1 BIT)

FIG. 19

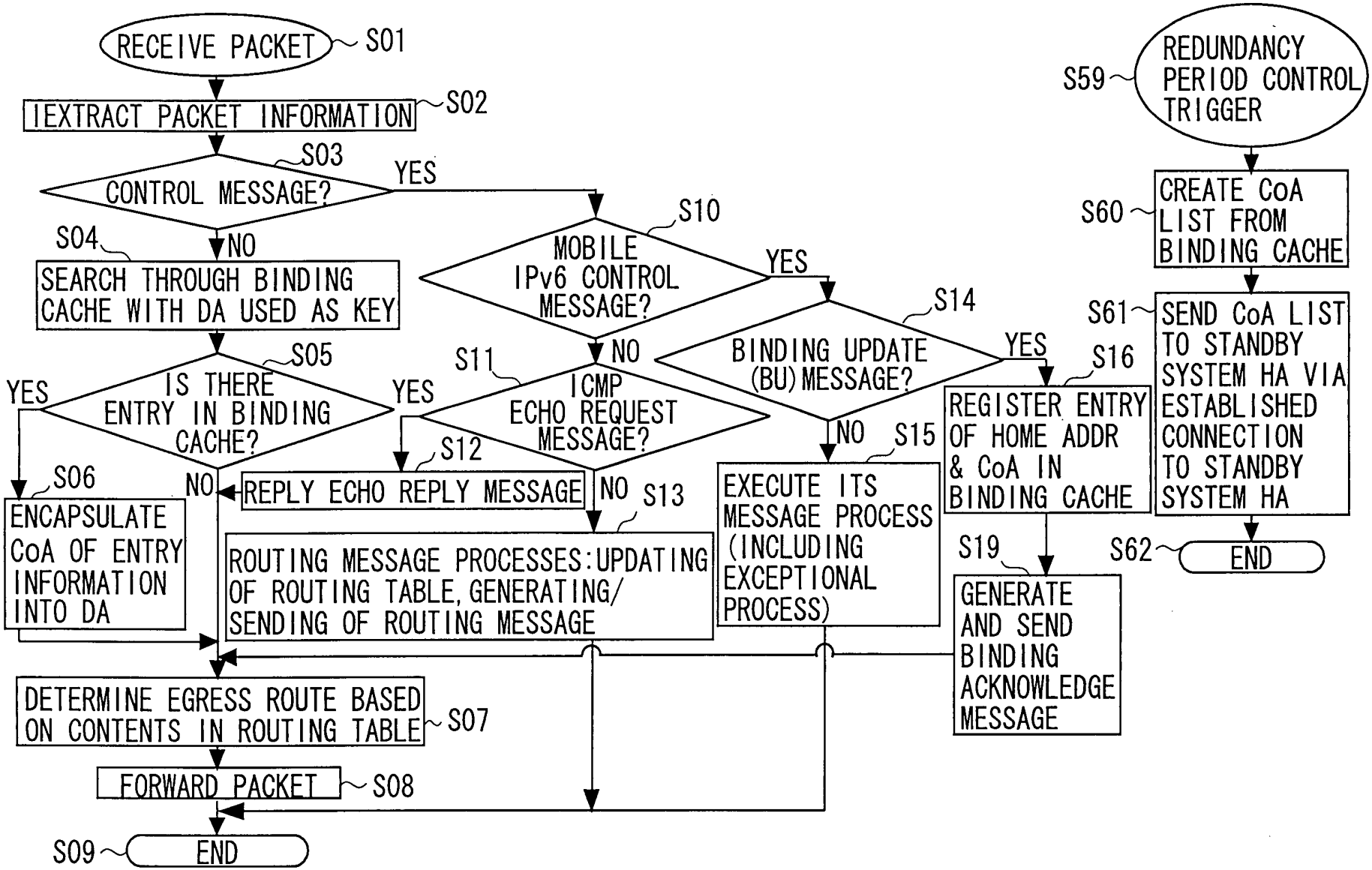

RECEIVE PACKET
S01
EXTRACT PACKET INFORMATION
S02
CONTROL MESSAGE?
S03
YES
NO
S04
SEARCH THROUGH BINDING CACHE WITH DA USED AS KEY
IS THERE ENTRY IN BINDING CACHE?
S05
YES
NO
S06
ENCAPSULATE CoA OF ENTRY INFORMATION INTO DA
DETERMINE EGRESS ROUTE BASED ON CONTENTS IN ROUTING TABLE
S07
FORWARD PACKET
S08
END
S09
MOBILE IPv6 CONTROL MESSAGE?
S10
YES
NO
ICMP ECHO REQUEST MESSAGE?
S11
YES
NO
REPLY ECHO REPLY MESSAGE
S12
NO
S13
ROUTING MESSAGE PROCESSES:UPDATING OF ROUTING TABLE, GENERATING/ SENDING OF ROUTING MESSAGE
BINDING UPDATE (BU) MESSAGE?
S14
YES
NO
S15
EXECUTE ITS MESSAGE PROCESS (INCLUDING EXCEPTIONAL PROCESS)
REGISTER ENTRY OF HOME ADDR & CoA IN BINDING CACHE
S16
S19
GENERATE AND SEND BINDING ACKNOWLEDGE MESSAGE
REDUNDANCY PERIOD CONTROL TRIGGER
S59
CREATE CoA LIST FROM BINDING CACHE
S60
SEND CoA LIST TO STANDBY SYSTEM HA VIA ESTABLISHED CONNECTION TO STANDBY SYSTEM HA
S61
END
S62

FIG. 20

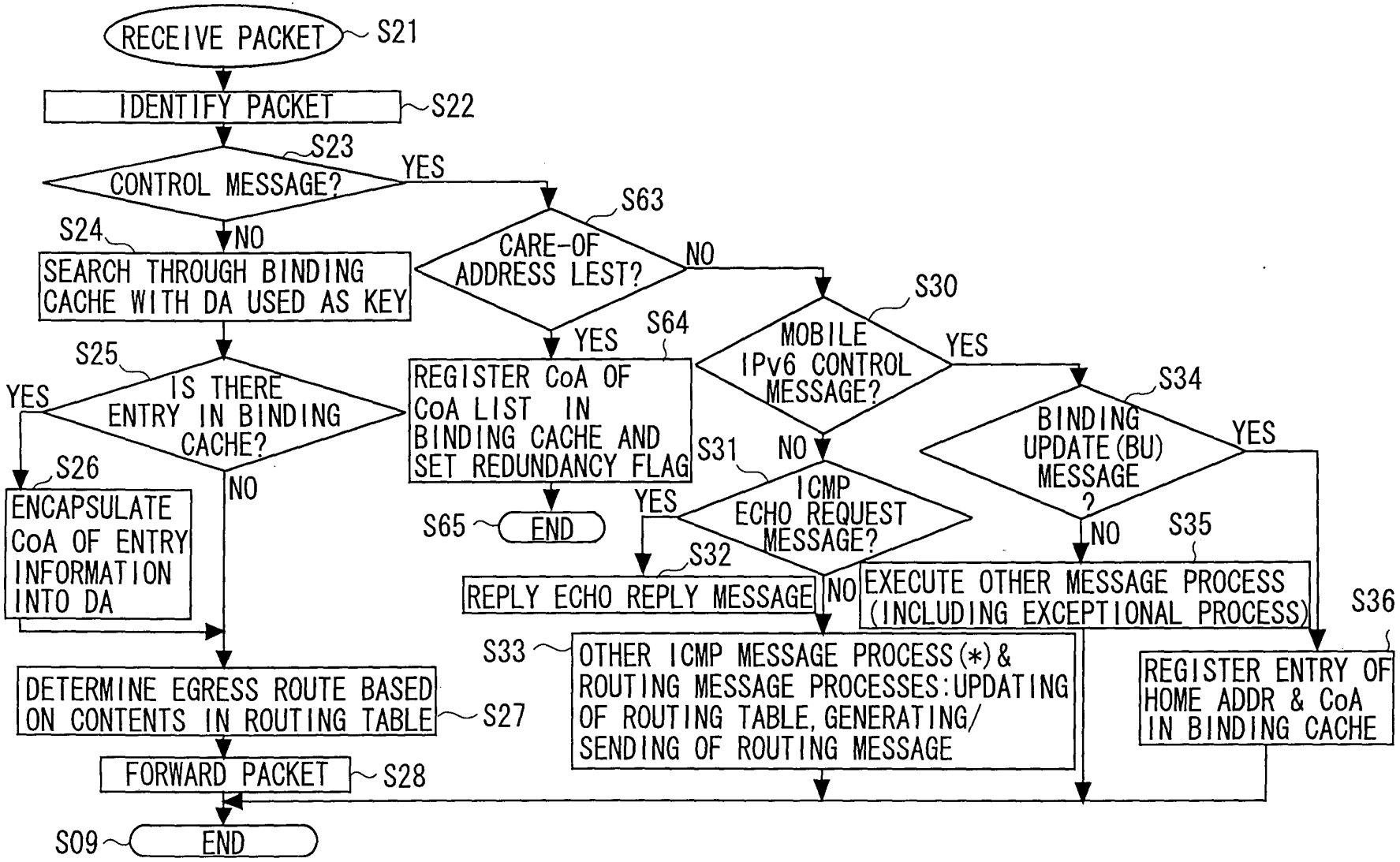

RECEIVE PACKET
S21
IDENTIFY PACKET
S22
S23
CONTROL MESSAGE?
YES
NO
S24
SEARCH THROUGH BINDING CACHE WITH DA USED AS KEY
S25
IS THERE ENTRY IN BINDING CACHE?
YES
NO
S26
ENCAPSULATE CoA OF ENTRY INFORMATION INTO DA
DETERMINE EGRESS ROUTE BASED ON CONTENTS IN ROUTING TABLE
S27
FORWARD PACKET
S28
S09
END
S63
CARE-OF ADDRESS LEST?
NO
YES
S64
REGISTER CoA OF CoA LIST IN BINDING CACHE AND SET REDUNDANCY FLAG
S65
END
S30
MOBILE IPv6 CONTROL MESSAGE?
YES
NO
S31
ICMP ECHO REQUEST MESSAGE?
YES
NO
S32
REPLY ECHO REPLY MESSAGE
S33
OTHER ICMP MESSAGE PROCESS(*) & ROUTING MESSAGE PROCESSES:UPDATING OF ROUTING TABLE, GENERATING/ SENDING OF ROUTING MESSAGE
S34
BINDING UPDATE(BU) MESSAGE ?
YES
NO
S35
EXECUTE OTHER MESSAGE PROCESS (INCLUDING EXCEPTIONAL PROCESS)
S36
REGISTER ENTRY OF HOME ADDR & CoA IN BINDING CACHE

FIG. 21

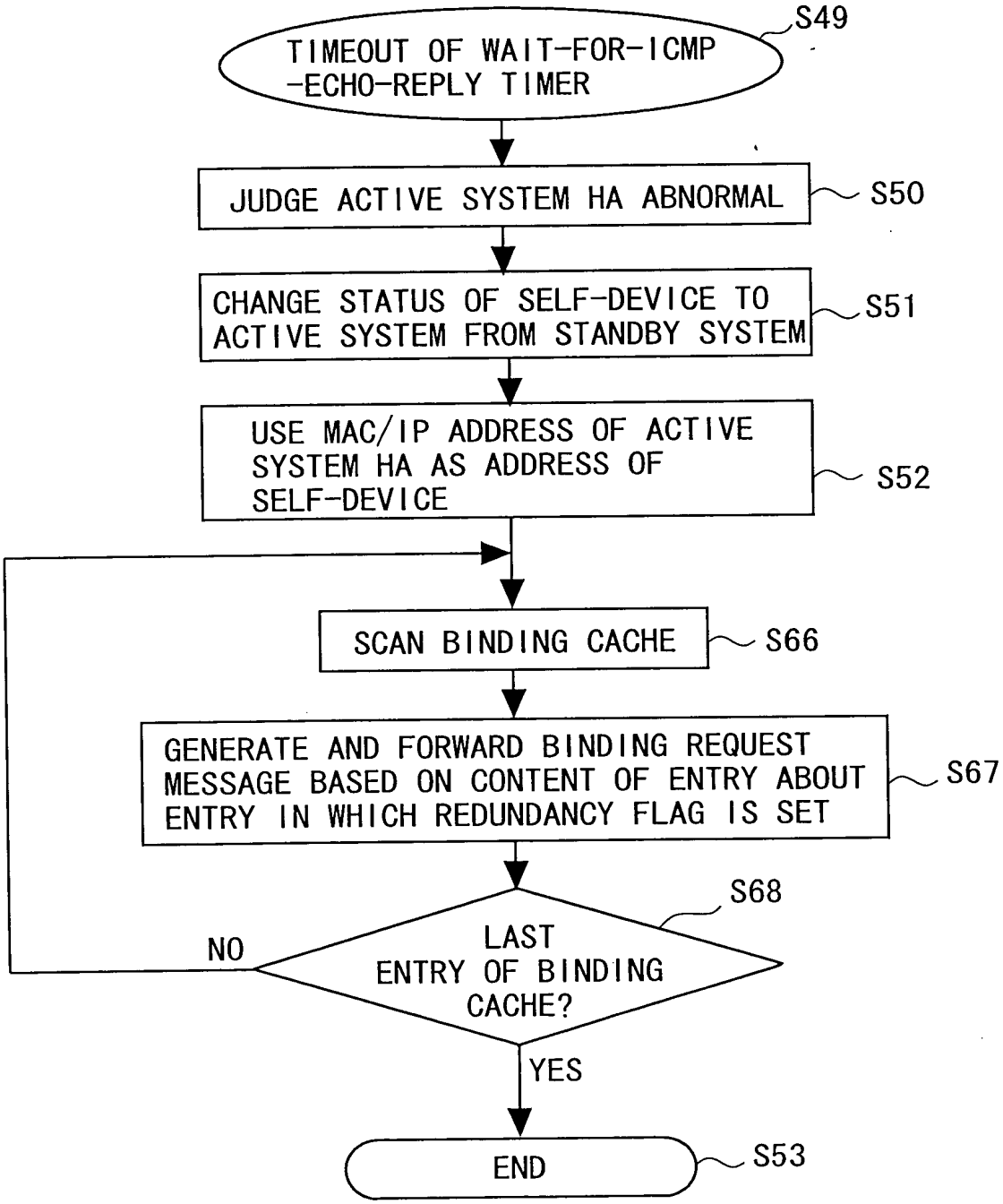

TIMEOUT OF WAIT-FOR-ICMP -ECHO-REPLY TIMER
S49
JUDGE ACTIVE SYSTEM HA ABNORMAL
S50
CHANGE STATUS OF SELF-DEVICE TO ACTIVE SYSTEM FROM STANDBY SYSTEM
S51
USE MAC/IP ADDRESS OF ACTIVE SYSTEM HA AS ADDRESS OF SELF-DEVICE
S52
SCAN BINDING CACHE
S66
GENERATE AND FORWARD BINDING REQUEST MESSAGE BASED ON CONTENT OF ENTRY ABOUT ENTRY IN WHICH REDUNDANCY FLAG IS SET
S67
LAST ENTRY OF BINDING CACHE?
S68
NO
YES
END
S53

FIG. 22

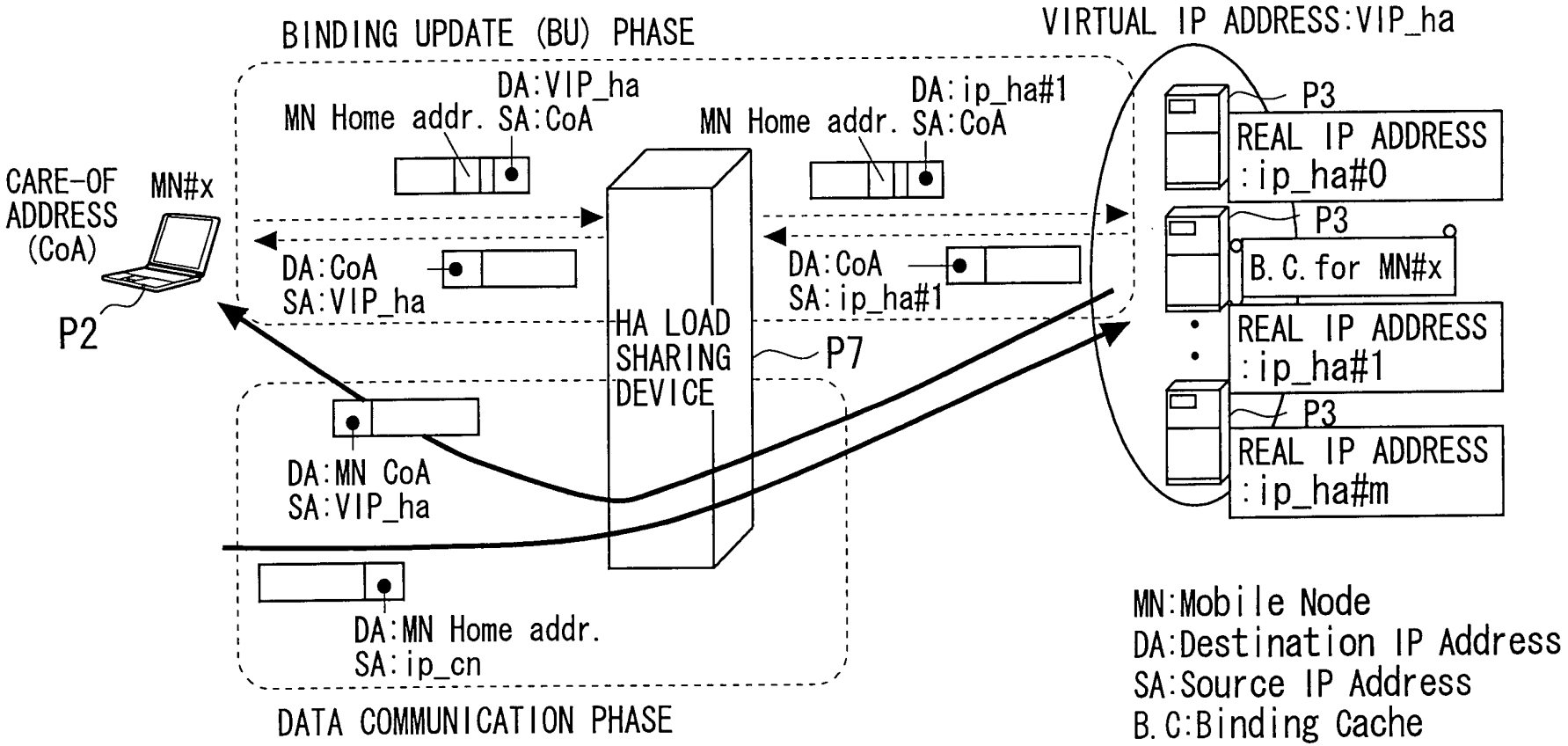

BINDING UPDATE (BU) PHASE
VIRTUAL IP ADDRESS:VIP_ha
DA:VIP_ha
MN Home addr. SA:CoA
DA:ip_ha#1
MN Home addr. SA:CoA
CARE-OF ADDRESS (CoA)
MN#x
P2
DA:CoA
SA:VIP_ha
DA:CoA
SA:ip_ha#1
HA LOAD SHARING DEVICE
P7
P3
REAL IP ADDRESS :ip_ha#0
P3
B.C. for MN#x
REAL IP ADDRESS :ip_ha#1
P3
REAL IP ADDRESS :ip_ha#m
DA:MN CoA
SA:VIP_ha
DA:MN Home addr.
SA:ip_cn
DATA COMMUNICATION PHASE
MN:Mobile Node
DA:Destination IP Address
SA:Source IP Address
B.C:Binding Cache

FIG. 23

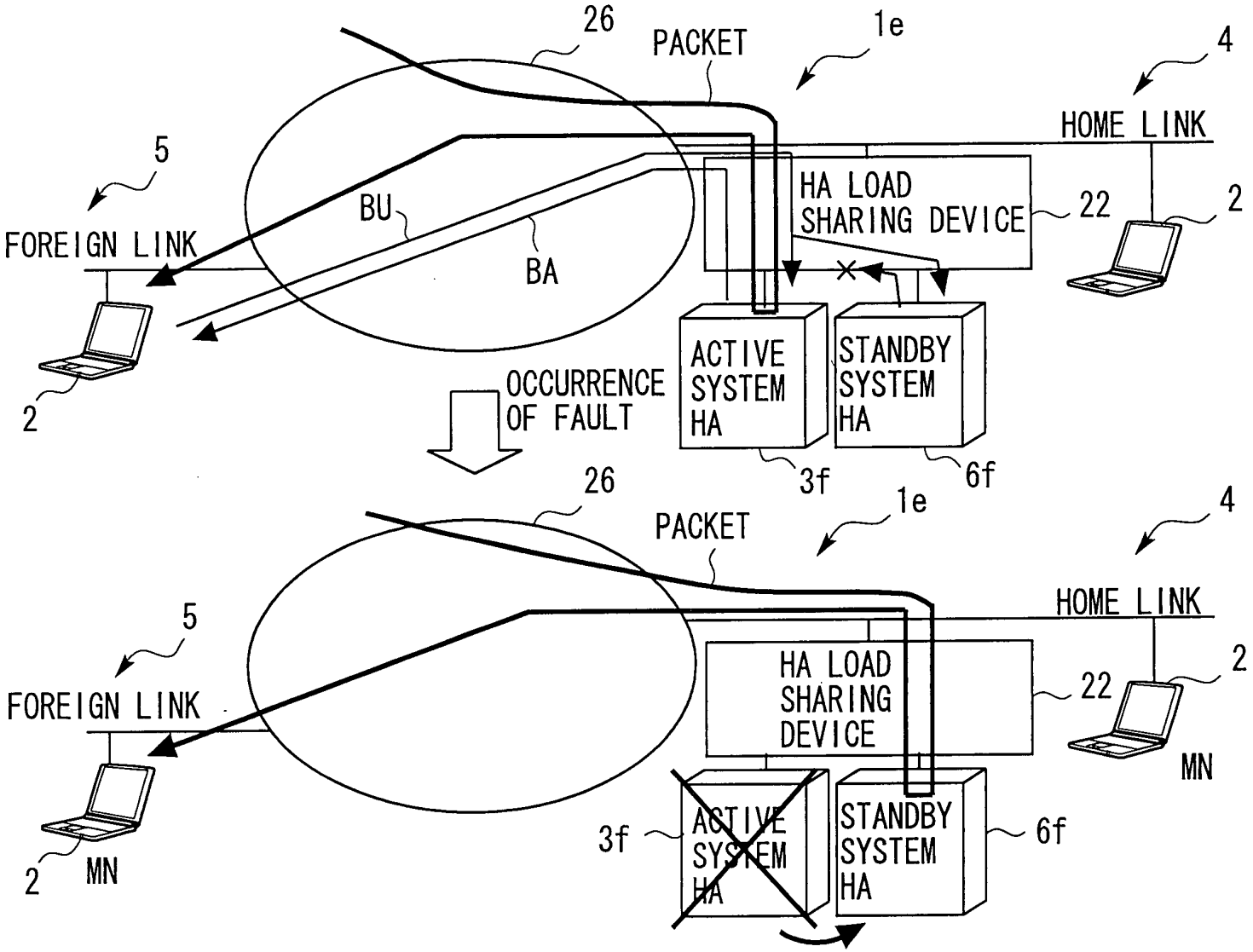

26
PACKET
1e
4
HOME LINK
5
FOREIGN LINK
BU
BA
HA LOAD SHARING DEVICE
22
2
ACTIVE SYSTEM HA
STANDBY SYSTEM HA
OCCURRENCE OF FAULT
3f
6f
2
MN

FIG. 24

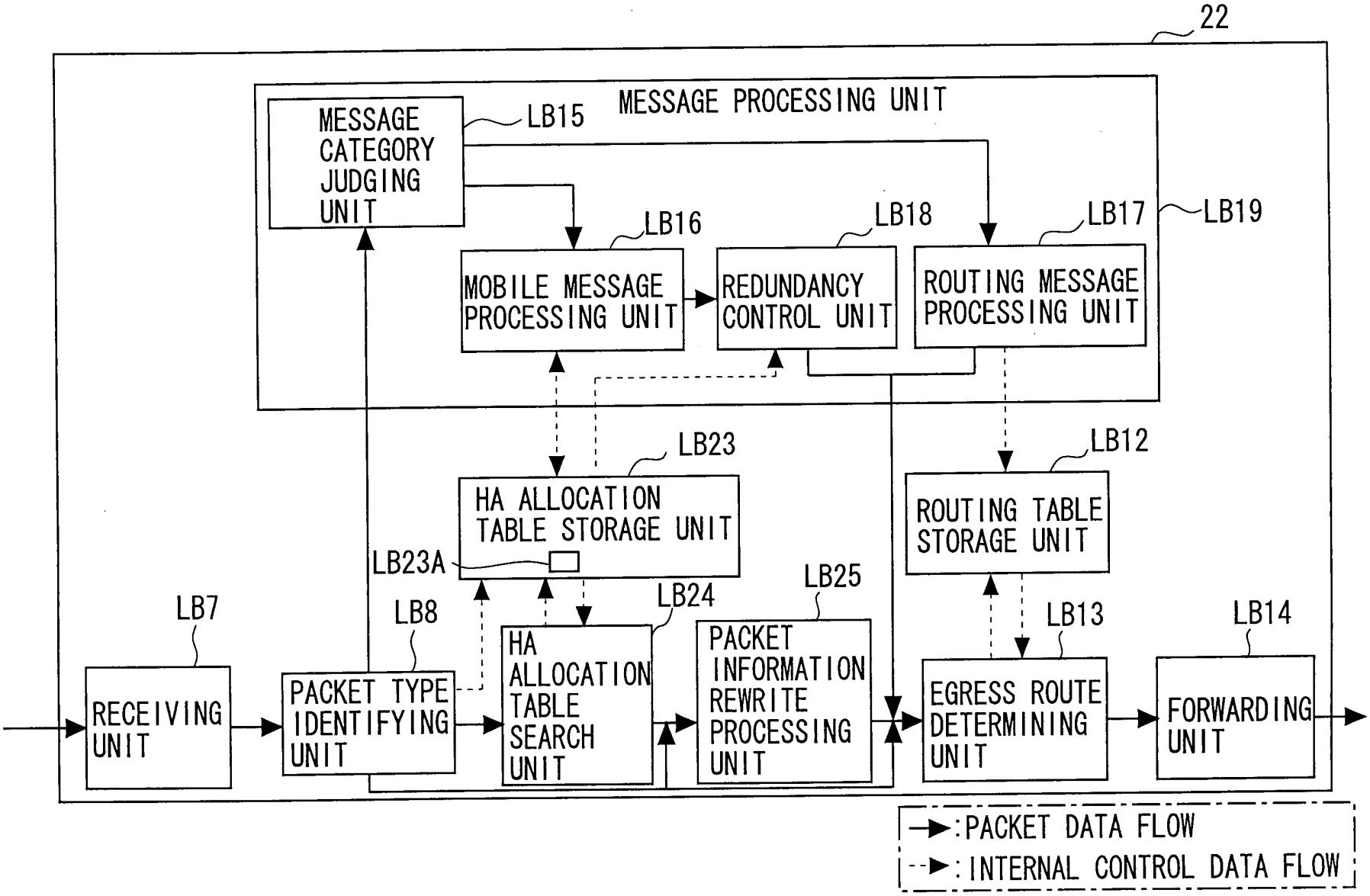

22
MESSAGE PROCESSING UNIT
MESSAGE CATEGORY JUDGING UNIT
LB15
LB16
LB18
LB17
LB19
MOBILE MESSAGE PROCESSING UNIT
REDUNDANCY CONTROL UNIT
ROUTING MESSAGE PROCESSING UNIT
LB23
LB12
HA ALLOCATION TABLE STORAGE UNIT
LB23A
ROUTING TABLE STORAGE UNIT
LB7
LB8
LB24
LB25
LB13
LB14
RECEIVING UNIT
PACKET TYPE IDENTIFYING UNIT
HA ALLOCATION TABLE SEARCH UNIT
PACKET INFORMATION REWRITE PROCESSING UNIT
EGRESS ROUTE DETERMINING UNIT
FORWARDING UNIT
:PACKET DATA FLOW
:INTERNAL CONTROL DATA FLOW

FIG. 25

LB23A

MN HOME ADDRESS	FORWARD DESTINATION HA ADDRESS	REDUNDANCY CONTROL INDICATING INFORMATION	STANDBY SYSTEM HA ADDRESS

FIG. 26

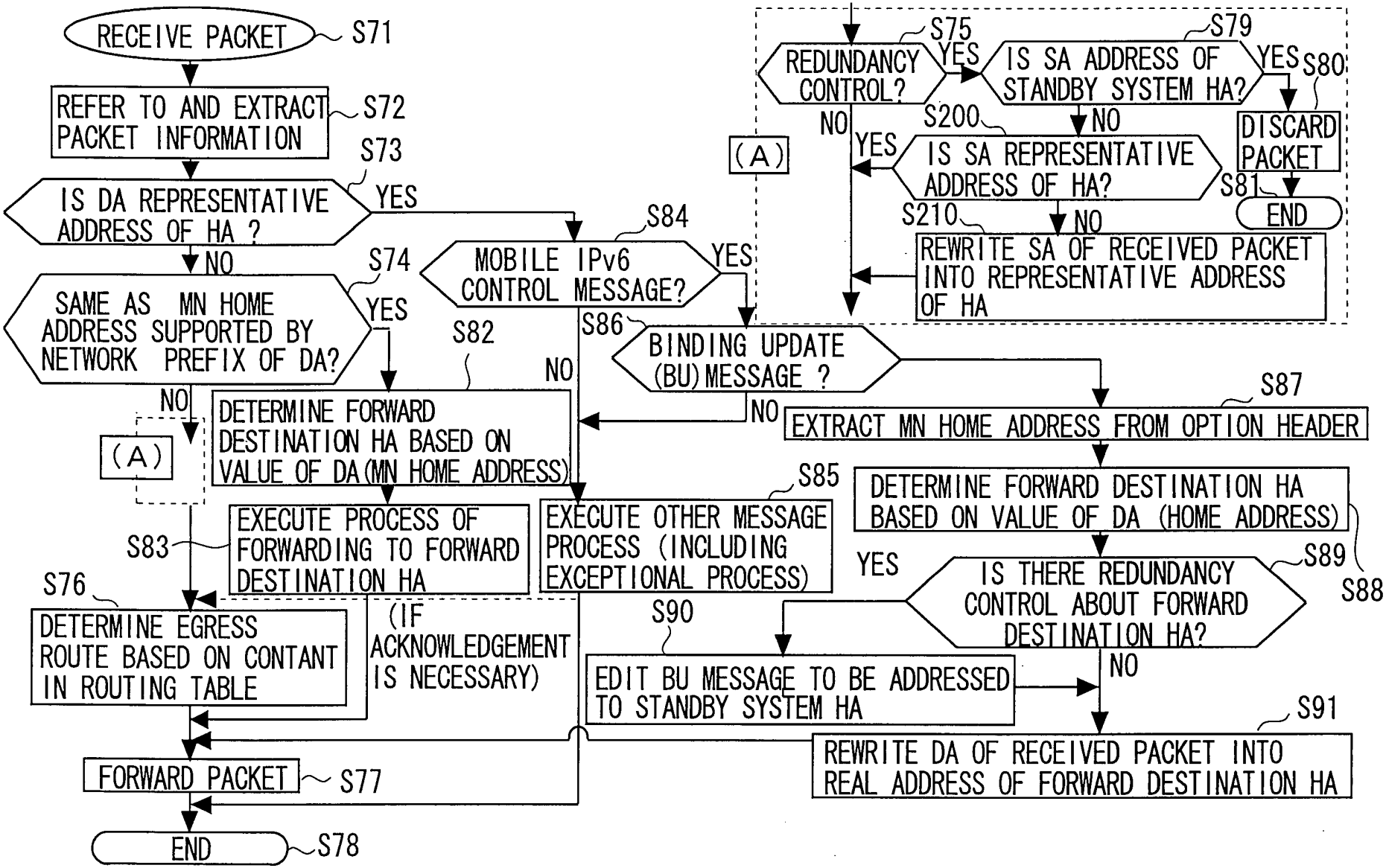

RECEIVE PACKET
S71
REFER TO AND EXTRACT PACKET INFORMATION
S72
IS DA REPRESENTATIVE ADDRESS OF HA ?
S73
YES
NO
SAME AS MN HOME ADDRESS SUPPORTED BY NETWORK PREFIX OF DA?
S74
YES
NO
(A)
DETERMINE FORWARD DESTINATION HA BASED ON VALUE OF DA(MN HOME ADDRESS)
S82
EXECUTE PROCESS OF FORWARDING TO FORWARD DESTINATION HA
S83
DETERMINE EGRESS ROUTE BASED ON CONTANT IN ROUTING TABLE
S76
(IF ACKNOWLEDGEMENT IS NECESSARY)
FORWARD PACKET
S77
END
S78
MOBILE IPv6 CONTROL MESSAGE?
S84
YES
NO
BINDING UPDATE (BU) MESSAGE ?
S86
YES
NO
EXECUTE OTHER MESSAGE PROCESS (INCLUDING EXCEPTIONAL PROCESS)
S85
EXTRACT MN HOME ADDRESS FROM OPTION HEADER
S87
DETERMINE FORWARD DESTINATION HA BASED ON VALUE OF DA (HOME ADDRESS)
S88
IS THERE REDUNDANCY CONTROL ABOUT FORWARD DESTINATION HA?
S89
YES
NO
EDIT BU MESSAGE TO BE ADDRESSED TO STANDBY SYSTEM HA
S90
REWRITE DA OF RECEIVED PACKET INTO REAL ADDRESS OF FORWARD DESTINATION HA
S91
(A)
REDUNDANCY CONTROL?
S75
YES
NO
IS SA ADDRESS OF STANDBY SYSTEM HA?
S79
YES
NO
DISCARD PACKET
S80
END
S81
IS SA REPRESENTATIVE ADDRESS OF HA?
S200
YES
NO
REWRITE SA OF RECEIVED PACKET INTO REPRESENTATIVE ADDRESS OF HA
S210

FIG. 27

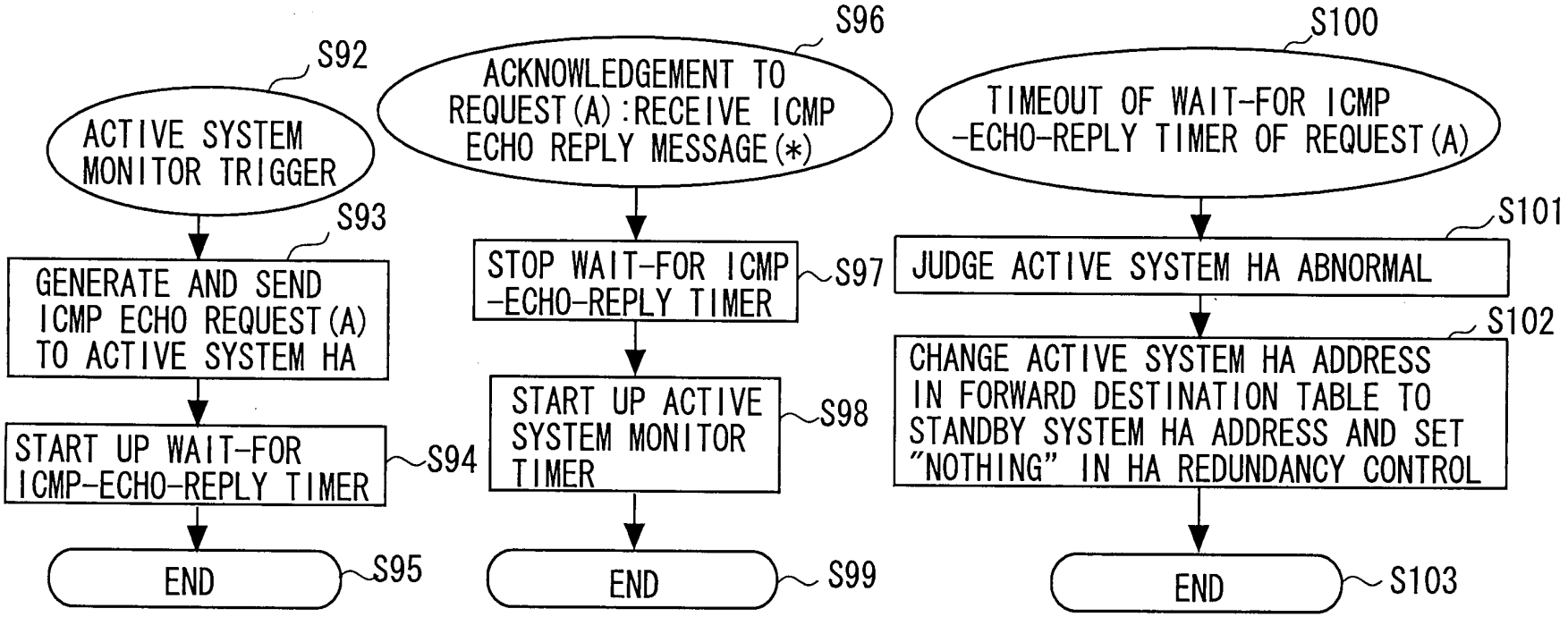
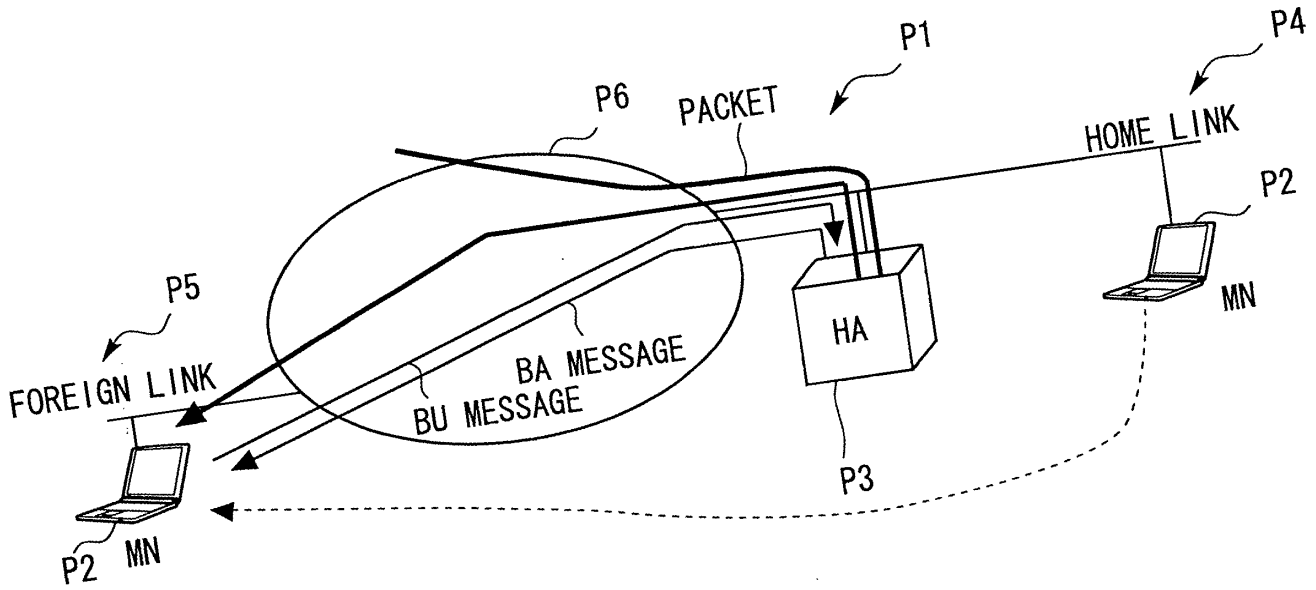

S92
ACTIVE SYSTEM MONITOR TRIGGER
S93
GENERATE AND SEND ICMP ECHO REQUEST(A) TO ACTIVE SYSTEM HA
START UP WAIT-FOR ICMP-ECHO-REPLY TIMER
S94
END
S95
S96
ACKNOWLEDGEMENT TO REQUEST(A):RECEIVE ICMP ECHO REPLY MESSAGE(*)
STOP WAIT-FOR ICMP-ECHO-REPLY TIMER
S97
START UP ACTIVE SYSTEM MONITOR TIMER
S98
END
S99
S100
TIMEOUT OF WAIT-FOR ICMP-ECHO-REPLY TIMER OF REQUEST(A)
S101
JUDGE ACTIVE SYSTEM HA ABNORMAL
S102
CHANGE ACTIVE SYSTEM HA ADDRESS IN FORWARD DESTINATION TABLE TO STANDBY SYSTEM HA ADDRESS AND SET "NOTHING" IN HA REDUNDANCY CONTROL
END
S103

FIG. 28


P1
P4
P6
PACKET
HOME LINK
P2
P5
HA
MN
FOREIGN LINK
BA MESSAGE
BU MESSAGE
P3
P2
MN